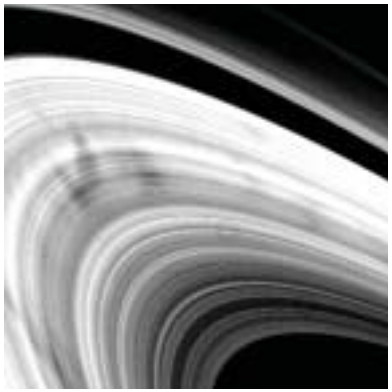
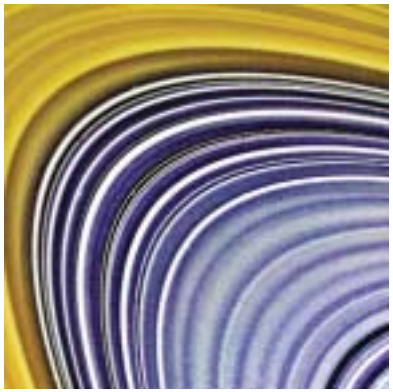
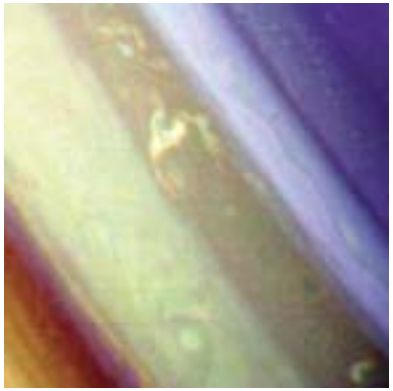
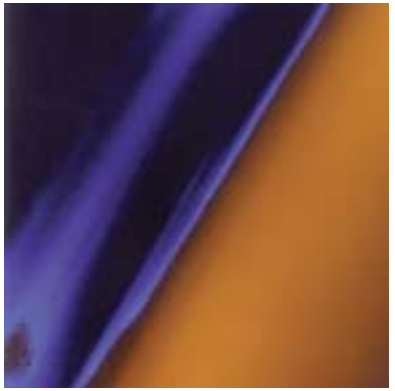
National Aeronautics and
Space Administration

Saturn









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SATURN is the most distant of the five planets known to ancient stargazers. In 1610, Italian Galileo Galilei was the first astronomer to gaze at Saturn through a telescope. To his surprise, he saw a pair of objects on either side of the planet, which he later drew as "cup handles" attached to the planet on each side. In 1659, Dutch astronomer Christiaan Huygens announced that this was a ring encircling the planet. In 1675, Italian-born astronomer Jean Dominique Cassini discovered a gap between what are now called the A and B rings.

Like the other giant planets—Jupiter, Uranus, and Neptune—Saturn is a gas giant made mostly of hydrogen and helium. Its volume is 755 times greater than Earth's. Winds in the upper atmosphere reach 500 meters per second in the equatorial region. (In contrast, the strongest hurricane-force winds on Earth top out at about 110 meters per second.) These super-fast winds, combined with heat rising from within the planet's interior, cause the yellow and gold bands visible in its atmosphere.

Saturn's ring system is the most extensive and complex in our solar system; it extends hundreds of thousands of kilometers from the planet. In fact, Saturn and its rings would just fit in the distance between Earth and the Moon. In the early 1980s, NASA's two *Voyager* spacecraft revealed that Saturn's rings are made mostly of water ice, and they found "braided" rings, ringlets, and "spokes"—dark features in the rings that seem to circle the planet at a different rate from that of the surrounding ring material. Some of the small moons orbit within the ring system as well. Material in the rings ranges in size from a few micrometers to several tens of meters.

Saturn has at least 30 satellites. The largest, Titan, is a bit bigger than the planet Mercury. Titan is shrouded in a thick nitrogen-rich atmosphere that might be similar to what Earth's was like long ago. Further study of this moon promises to reveal much about planetary formation and, perhaps, about the early days of Earth as well.

In addition to Titan, Saturn has many smaller "icy" satellites. From Enceladus, which shows evidence of surface changes, to Iapetus, with one hemisphere darker than asphalt and the other as bright as snow, each of Saturn's satellites is unique.

Saturn, the rings, and many of the satellites lie totally within Saturn's enormous magnetosphere, the region of space in which the behavior of electrically charged particles is influenced more by Saturn's magnetic field than by the solar wind. Recent images by NASA's *Hubble Space Telescope* show that Saturn's polar regions have aurorae similar to Earth's Northern and Southern Lights. Aurorae occur when charged particles spiral into a planet's atmosphere along magnetic field lines.

The next chapter in our knowledge of Saturn is already under way, as the *Cassini/Huygens* spacecraft began its journey to Saturn in October 1997 and will arrive on July 1, 2004. The *Huygens* probe will descend through Titan's atmosphere in late November 2004 to collect data on the atmosphere and surface of the moon. *Cassini* will orbit Saturn more than 70 times during a four-year study of the planet, its moons, rings, and magnetosphere. *Cassini/Huygens* is a joint NASA/European Space Agency mission.

Fast Facts

Namesake	Roman God of Agriculture
Mean Distance from Sun	1.427 billion km
Orbital Period	29.42 years
Orbital Eccentricity	0.054
Orbital Inclination to Ecliptic	2.5°
Inclination of Equator to Orbit	26.73°
Rotational Period	10 h 39 m
Equatorial Diameter	120,536 km
Mass	95.16 times Earth's mass
Density	0.70 gm/cm^3
Gravity	0.91 of Earth's
Atmosphere (primary components)	97% Hydrogen, 3% Helium
Atmospheric Temperature at 1-bar Pressure Level	134 K

Moons (30) in Increasing Distance from Saturn

Pan, Atlas, Prometheus, Pandora, Epimetheus, Janus, Mimas, Enceladus, Tethys, Telesto, Calypso, Dione, Helene, Rhea, Titan, Hyperion, Iapetus, S/2000 S5, S/2000 S6, Phoebe, S/2000 S2, 8, 3, 10, 11, 4, 9, 12, 7, 1 (the new satellites are numbered in order of discovery and their orbits are still uncertain)

Rings in Increasing Distance from Saturn

D, C, B, (Cassini Division), A, F, G, E

Significant Dates

1610 Galileo Galilei observes Saturn's odd appearance and behavior.
1659 Christiaan Huygens discovers that Saturn has rings that are not attached to the planet.
1675 Jean Dominique Cassini discovers a gap in the rings.
1979 *Pioneer 11* passes within 22,000 km of Saturn's cloud tops.
1980 *Voyager 1* passes within 125,000 km of Saturn's cloud tops.
1981 *Voyager 2* passes within 101,000 km of Saturn's cloud tops.
1994 *Hubble Space Telescope*'s Wide Field/Planetary Camera 2 sees evidence of surface features on Titan.
1997 *Cassini/Huygens* spacecraft begins journey to Saturn and Titan.
2004 *Cassini/Huygens* arrives at Saturn and begins in-depth study of the Saturnian system.

About the Images

(Left, top) This approximate natural-color image shows Saturn, its rings, and four of its icy satellites. Three satellites (Tethys, Dione, and Rhea) are visible against the darkness of space, and Mimas is visible against Saturn's cloud tops very near the left horizon and just below the rings. Saturn's rings orbit the planet in a vast disk that is a mere 100 meters or so thick. The bright A ring is the outermost ring visible here. The Cassini Division is a 3,500-km-wide gap in the rings (NASA/*Voyager 2*).
(Right, top) Dark spokes rotate in Saturn's rings (NASA/*Voyager 2*).
(Right, center) False color shows differing surface compositions for the material in Saturn's C-ring (center) and B-ring (left). The C-ring material is generally the color of dirty ice (NASA/*Voyager 2*).
(Left, bottom) False color makes the banding caused by fast winds and internal heat easier to see.
(Left, bottom center) False color shows small cloud features and a longitudinal wave in Saturn's northern hemisphere (NASA/*Voyager 1*).
(Right, bottom center) False color shows detail of haze layers covering Titan (NASA/*Voyager 1*).
(Right, bottom) Enceladus is a tiny ice ball that has been geologically active and perhaps partially liquid in its interior for much of its history (NASA/*Voyager 2*).

References
1) *Cassini/Huygens* Mission to Saturn and Titan: *http://www.jpl.nasa.gov/cassini*
2) Summary of *Voyager* Science Results at Saturn: *http://vraptor.jpl.nasa.gov/voyager/vgrsat_fs.html*
3) Planetary Photojournal: *http://photojournal.jpl.nasa.gov*

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